Stray Currents:

Bearing Current Damage

References

[1] Jitendra Kumar Katiyar T. et al., editors. Tribology in Sustainable Manufacturing. CRC Press Taylor & Francis Group; 2024.

[2] Okokpujie IP, Tartibu LK, Musa-Basheer HO, Adeoye AOM. Effect of Coatings on Mechanical, Corrosion and Tribological Properties of Industrial Materials: A Comprehensive Review. J Bio- Tribo-Corrosion 2024;10:2. https://doi.org/10.1007/s40735-023-00805-1

[3] VENUGOPAL A, ROBERT F. Optimization of Laminated Busbars in Traction Inverters of Electric Vehicles for Improved Stray Parameters. Adv Electr Comput Eng 2023;23:85–92. https://doi.org/10.4316/AECE.2023.02010

[4] Venugopal A, Robert F. Optimization of Laminated Busbars in Traction Inverters of Electric Vehicles for Improved Stray Parameters. Adv Electr Comput Eng 2023;23:85–92. https://doi.org/10.4316/AECE.2023.02010

[5] Sharma SK, Grewal HS. Tribological Behavior of Bioinspired Surfaces. Biomimetics 2023;8. https://doi.org/10.3390/biomimetics8010062

[6] Teshale A, Biru G. Overview of shaft voltage and bearing current mitigation methods applied on the victim machine. Electr Eng 2023. https://doi.org/10.1007/s00202-023-02075-z .

[7] Ferreira R, Carvalho Ó, Sobral L, Carvalho S, Silva F. Laser texturing of piston ring for tribological performance improvement. Friction 2023;11:1895–905. https://doi.org/10.1007/s40544-022-0723-5 .

[8] De Gaetano D, Zhu W, Sun X, Chen X, Griffo A, Jewell GW. Experimental Ball Bearing Impedance Analysis Under Different Speed and Electrical Conditions. IEEE Trans Dielectr Electr Insul 2023;30:1312–21. https://doi.org/10.1109/TDEI.2023.3271958 .

[9] Chiba M, Tsuji Y, Takada R, Eguchi Y, Takahashi H. Formation of Self-Healing Organic Coatings for Corrosion Protection of Al Alloys by Dispersion of Spherical and Fibrous Capsules. Materials (Basel) 2023;16. https://doi.org/10.3390/ma16083018 .

[10] Ciulli E. Friction Models for a Sustainable Design: Friction Coefficient in Lubricated Conformal Pairs. Mech Mach Sci 2023;134 MMS:199–208. https://doi.org/10.1007/978-3-031-32439-0_23 .

[11] Bhagat S, Bongiorno J, Mariscotti A. Uncertainty of Standardized Track Insulation Measurement Methods for Stray Current Assessment. Sensors 2023;23:5900. https://doi.org/10.3390/s23135900 .

[12] Bhagat S, Bongiorno J, Mariscotti A. Uncertainty of Standardized Track Insulation Measurement Methods for Stray Current Assessment. Sensors 2023;23:1–19. https://doi.org/10.3390/s23135900 .

[13] Aguilar-Rosas OA, Farfan-Cabrera LI, Erdemir A, Cao-Romero-Gallegos JA. Electrified four-ball testing – A potential alternative for assessing lubricants (E-fluids) for electric vehicles. Wear 2023;522:204676. https://doi.org/10.1016/j.wear.2023.204676 .

[14] Farfan-Cabrera LI, Cao-Romero-Gallegos JA, Lee S, Komurlu MU, Erdemir A. Tribological behavior of H-DLC and H-free DLC coatings on bearing materials under the influence of DC electric current discharges. Wear 2023;522:204709. https://doi.org/10.1016/j.wear.2023.204709 .

[15] Cao-Romero-Gallegos JA, Farfan-Cabrera LI, Erdemir A, Pascual-Francisco JB. Lubricated sliding wear of gear material under electrification – A new approach to understanding of the influence of shaft currents in the wear of EV transmissions. Wear 2023;523:204782. https://doi.org/10.1016/j.wear.2023.204782 .

[16] Gimeno S, Mescheder H, Quintana I, Gasión A, Arias-Egido E, Carbonell A, et al. Effect of different laser texturing patterns on rolling contact surface and its tribological & fatigue life behavior on 100Cr6 bearing steel. Wear 2023;522. https://doi.org/10.1016/j.wear.2023.204717 .

[17] López-Uruñuela FJ, Wang L, Fernández B, Aguirrebeitia J, Pinedo B. A study on the three key concepts of White Etching Crack failure mode in its very early stages - Contrast with different testing methods. Wear 2023;530–531. https://doi.org/10.1016/j.wear.2023.205044 .

[18] Farfan-Cabrera LI, Erdemir A, Cao-Romero-Gallegos JA, Alam I, Lee S. Electrification effects on dry and lubricated sliding wear of bearing steel interfaces. Wear 2023;516–517:204592. https://doi.org/10.1016/j.wear.2022.204592 .

[19] Zhu W, De Gaetano D, Chen X, Jewell GW, Hu Y. A Review of Modeling and Mitigation Techniques for Bearing Currents in Electrical Machines With

Variable-Frequency Drives. IEEE Access 2022;10:125279–97. https://doi.org/10.1109/ACCESS.2022.3225119 .

[20] Zhi Y, Li Y, Yan G, Gao Z, Qiu L, Fang Y. Review of Motor Bearing Currents in Inverter Drive System. Lect Notes Electr Eng 2022;891 LNEE:672–83. https://doi.org/10.1007/978-981-19-1532-1_71 .

[21] Schneider V, Behrendt C, Höltje P, Cornel D, Becker-Dombrowsky FM, Puchtler S, et al. Electrical Bearing Damage, A Problem in the Nano- and Macro-Range. Lubricants 2022;10:1–20. https://doi.org/10.3390/lubricants10080194 .

[22] Freschi M, Paniz A, Cerqueni E, Colella G, Dotelli G. The Twelve Principles of Green Tribology: Studies, Research, and Case Studies—A Brief Anthology. Lubricants 2022;10. https://doi.org/10.3390/lubricants10060129 .

[23] Ma J, Xue Y, Han Q, Li X, Yu C. Motor Bearing Damage Induced by Bearing Current: A Review. Machines 2022;10. https://doi.org/10.3390/machines10121167 .

[24] Ciulli E. Tribology and Sustainable Development Goals. Mech. Mach. Sci., vol. 108 MMS, 2022, p. 438–47. https://doi.org/10.1007/978-3-030-87383-7_48 .

[25] Steinweg F, Mikitisin A, Oezel M, Schwedt A, Janitzky T, Hallstedt B, et al. Formation of White Etching Cracks under electrical current flow - Influence of load, slip and polarity. Wear 2022;504–505:204394. https://doi.org/10.1016/j.wear.2022.204394 .

[26] Pruncu CI, Aherwar A, Grob S. Tribology and Surface Engineering for Industrial Applications. 2021.

[27] Long R, Pan Z, Jin Z, Zhang Y, Sun S, Wang Y, et al. Tribological behavior of grooves textured thrust cylindrical roller bearings under dry wear. Adv Mech Eng 2021;13:168781402110672. https://doi.org/10.1177/16878140211067284 .

[28] Gould B, Demas N, Erck R, Lorenzo-Martin MC, Ajayi O, Greco A. The effect of electrical current on premature failures and microstructural degradation in bearing steel. Int J Fatigue 2021;145:106078. https://doi.org/10.1016/j.ijfatigue.2020.106078 .

[29] Robles E, Fernandez M, Andreu J, Ibarra E, Ugalde U. Advanced power inverter topologies and modulation techniques for common-mode voltage elimination in electric motor drive systems. Renew Sustain Energy Rev 2021;140:110746. https://doi.org/10.1016/j.rser.2021.110746 .

[30] Chen Q, Yu A, Zhao S, Wu M, Yuan J, Sun L, et al. Effect of magnetic field on tribological performance of laser dimple textured surface. Wear 2021;468–469:203584. https://doi.org/10.1016/j.wear.2020.203584 .

[31] Mei G. Impact of voltage on the electric sliding tribological properties of current collectors against overhead lines. Wear 2021;474–475:203868. https://doi.org/10.1016/j.wear.2021.203868 .

[32] Han P, Heins G, Patterson D, Thiele M, Ionel DM. Combined Numerical and Experimental Determination of Ball Bearing Capacitances for Bearing Current Prediction. ECCE 2020 - IEEE Energy Convers Congr Expo 2020:5590–4. https://doi.org/10.1109/ECCE44975.2020.9235700 .

[33] Han P, Heins G, Patterson D, Thiele M, Ionel DM. Evaluation of Bearing Voltage Reduction in Electric Machines by Using Insulated Shaft and Bearings. ECCE 2020 - IEEE Energy Convers Congr Expo 2020:5584–9. https://doi.org/10.1109/ECCE44975.2020.9235474 .

[34] He F, Xie G, Luo J. Electrical bearing failures in electric vehicles. Friction 2020;8:4–28. https://doi.org/10.1007/s40544-019-0356-5 .

[35] Meng Y, Xu J, Jin Z, Prakash B, Hu Y. A review of recent advances in tribology. vol. 8. 2020. https://doi.org/10.1007/s40544-020-0367-2 .

[36] Vrček A, Hultqvist T, Johannesson T, Marklund P, Larsson R. Micro-pitting and wear characterization for different rolling bearing steels: Effect of hardness and heat treatments. Wear 2020;458–459. https://doi.org/10.1016/j.wear.2020.203404 .

[37] JOSHI A. Electrical Characterisations of Bearings, Thesis, 2019.

[38] Ciulli E. Tribology and Industry: From the Origins to 4.0. Front Mech Eng 2019;5:1–12. https://doi.org/10.3389/fmech.2019.00055 .

[39] Popov VL. Is Tribology Approaching Its Golden Age? Grand Challenges in Engineering Education and Tribological Research. Front Mech Eng 2018;4:1–6. https://doi.org/10.3389/fmech.2018.00016 .

[40] Kumar V, Sharma SC. Finite element method analysis of hydrostatic thrust pad bearings operating with electrically conducting lubricant. Proc Inst Mech Eng Part J J Eng Tribol 2018;232:1318–31. https://doi.org/10.1177/1350650117753530 .

[41] Poljanec D, Kalin M, Kumar L. Influence of contact parameters on the tribological behaviour of various graphite/graphite sliding electrical contacts. Wear 2018;406–407:75–83. https://doi.org/10.1016/j.wear.2018.03.022 .

[42] TENGXI W. Analysis of Ball Bearing Defects in Synchronous Machines. 2017.

[43] Leferink F. Preventing lightning damage in bearings by using mechanical preloading. Electr Power Syst Res 2017;153:152–8. https://doi.org/10.1016/j.epsr.2016.10.004 .

[44] Myshkin NK, Konchits V V. Tribology of electrical contacts. Tribol Und Schmierungstechnik 2017;64:5–12. https://doi.org/10.1007/978-0-387-92897-5_1061 .

[45] Danielsen HK, Guzmán FG, Dahl K V., Li YJ, Wu J, Jacobs G, et al. Multiscale characterization of White Etching Cracks (WEC) in a 100Cr6 bearing from a thrust bearing test rig. Wear 2017;370–371:73–82. https://doi.org/10.1016/j.wear.2016.11.016

[46] Gutiérrez Guzmán F, Oezel M, Jacobs G, Burghardt G, Broeckmann C, Janitzky T. Reproduction of white etching cracks under rolling contact loading on thrust bearing and two-disc test rigs. Wear 2017;390–391:23–32. https://doi.org/10.1016/j.wear.2017.06.020.

[47] Sharma V, Pandey PM. Recent advances in turning with textured cutting tools: A review. J Clean Prod 2016;137:701–15. https://doi.org/10.1016/j.jclepro.2016.07.138 .

[48] Zhang S-W. Recent developments of green tribology. Surf Topogr Metrol Prop 2016;4:023004. https://doi.org/10.1088/2051-672X/4/2/023004 .

[49] Lai J, Stadler K. Investigation on the mechanisms of white etching crack (WEC) formation in rolling contact fatigue and identification of a root cause for bearing premature failure. Wear 2016;364–365:244–56. https://doi.org/10.1016/j.wear.2016.08.001 .

[50] Bucca G, Collina A. Electromechanical interaction between carbon-based pantograph strip and copper contact wire: A heuristic wear model. Tribol Int 2015;92:47–56. https://doi.org/10.1016/j.triboint.2015.05.019 .

[51] Bruce T, Rounding E, Long H, Dwyer-Joyce RS. Characterisation of white etching crack damage in wind turbine gearbox bearings. Wear 2015;338–339:164–77. https://doi.org/10.1016/j.wear.2015.06.008 .

[52] Stachowiak WG, Batchelor AW. Engineering Tribology. Fouth Edit. Butterworth-Heinemann is an imprint of Elsevier; 2014.

[53] Chattopadhyay R. Green tribology, green surface engineering, and global warming. ASM International; 2014.

[54] Zhang S. Green tribology: Fundamentals and future development. Friction 2013;1:186–94. https://doi.org/10.1007/s40544-013-0012-4 .

[55] Davim JP. Green Manufacturing Processes and Systems. Berlin, Heidelberg: Springer Berlin Heidelberg; 2013. https://doi.org/10.1007/978-3-642-33792-5 .

[56] Xie G, Luo J, Guo D, Liu S, Li G. Damages on the lubricated surfaces in bearings under the influence of weak electrical currents. Sci China Technol Sci 2013;56:2979–87. https://doi.org/10.1007/s11431-013-5399-7 .

[57] Tzanakis I, Hadfield M, Thomas B, Noya SM, Henshaw I, Austen S. Future perspectives on sustainable tribology. Renew Sustain Energy Rev 2012;16:4126–40. https://doi.org/10.1016/j.rser.2012.02.064 .

[58] Raadnui S, Kleesuwan S. Electrical pitting wear debris analysis of grease-lubricated rolling element bearings. Wear 2011;271:1707–18. https://doi.org/10.1016/j.wear.2011.01.040 .

[59] Nosonovsky M, Bhushan B. Green tribology: principles, research areas and challenges. Philos Trans R Soc A Math Phys Eng Sci 2010;368:4677–94. https://doi.org/10.1098/rsta.2010.0200 .

[60] Chiou YC, Lee RT, Lin SM. Formation mechanism of electrical damage on sliding lubricated contacts for steel pair under DC electric field. Wear 2009;266:110–8. https://doi.org/10.1016/j.wear.2008.06.001 .

[61] Costabile G, De Vivo B, Egiziano L, Tucci V, Vitelli M, Beneduce L, et al. An accurate evaluation of electric discharge machining bearings currents in inverter-driven induction motors. 2007 Eur Conf Power Electron Appl EPE 2007. https://doi.org/10.1109/EPE.2007.4417329 .

[62] Dong L, Chen GX, Zhu MH, Zhou ZR. Wear mechanism of aluminum-stainless steel composite conductor rail sliding against collector shoe with electric current. Wear 2007;263:598–603. https://doi.org/10.1016/j.wear.2007.01.130 .

[63] Jagenbrein A, Buschbeck F, Gröschl M, Preisinger G. Investigation of the physical mechanisms in rolling bearings during the passage of electric current. TriboTest 2005;11:295–306. https://doi.org/10.1002/tt.3020110402 .

[64] Kogut L, Komvopoulos K. Electrical contact resistance theory for conductive rough surfaces separated by a thin insulating film. J Appl Phys 2004;95:576–85. https://doi.org/10.1063/1.1629392 .

[65] Prashad H. Diagnosis of rolling-element bearings failure by localized electrical current between track surfaces of races and rolling-elements. J Tribol 2002;124:468–73. https://doi.org/10.1115/1.1467638 .

[66] Yoo JS, Kim CH, Park KC, Han MK. Performance of polycrystalline silicon thin film transistors and CMOS driving circuits with various active films. Mater Res Soc Symp - Proc 1997;471:185–9. https://doi.org/10.1557/proc-471-185 .

[67] Hutchings IM. Tribology: friction and wear of engineering materials. vol. 13. 1992. https://doi.org/10.1016/0261-3069(92)90241-9 .

[68] Myshkin NK. Tribological problems in electrical contacts. Tribol Int 1991;24:45–9. https://doi.org/10.1016/0301-679X(91)90062-E .